Scientific Conference of COST Action 18105 "Risk-based meat inspection and integrated meat safety assurance"

15-16 October 2020 - ONLINE

Book of Abstracts

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Editors: Sophia Johler, Lis Alban & Bojan Blagojevic

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Scientific Committee

Bojan Blagojevic (Serbia)
Lis Alban (Denmark)
Ivar Vågsholm (Sweden)
Milen Georgiev (United Kingdom)
Diana Meemken (Germany)
Truls Nesbakken (Norway)
Dragan Antic (United Kingdom)
Kurt Houf (Belgium)
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About RIBMINS

RIBMINS (Risk-based meat inspection and integrated meat safety assurance) is a COST Action funded by the European Commission covering different activities in the period 2019-2023. The main aim of the RIBMINS network is to combine and strengthen European-wide research efforts on modern meat safety control systems. The network allows exchange of ideas, experience and results of country-level research studies. Other important aims are to create a platform for training relevant participants in the new meat safety assurance systems and thus help the operability, as well as to inform relevant stakeholders about the requirements, benefits and consequences of the new systems. Within RIBMINS, short-term scientific missions, training schools, workshops and conferences are organised. Overall, the network aims to help the full development and implementation of the general principles of meat safety assurance systems across Europe for the benefit of consumers and industry and protection of animal health and welfare.

During 2020, the Covid-19 pandemic has presented significant challenges to the RIBMINS work, but it also accelerated necessary changes in meat industry operations and related official controls.

The RIBMINS network scope of work, ongoing activities and news can be regularly followed at www.ribmins.com, as well as through social media (Twitter, LinkedIn, ResearchGate).

Participants of RIBMINS workshops and working group meetings held at the University of Copenhagen, Denmark (7th - 8th November 2019)

ABSTRACTS OF KEY-NOTE LECTURES

Does the recent EU revision of official controls result in a more risk-based meat inspection and integrated meat safety assurance?

Kris de Smet[1]

[1]Head of Team Food Hygiene, Unit G4 – Food Hygiene and Fraud, Directorate-General Health and Food Safety (SANTE), European Commission

Disclaimer: The information and views set out in this article are those of the author and do not necessarily reflect the official opinion of the European Commission.

On 14 December 2019, a revised meat inspection, laid down in Article 18 of the (new) official control Regulation (EU) 2017/625, supplemented by requirements in Commission Delegated Regulation (EU) 2019/624 and Commission Implementing Regulation (EU) 2019/627, came into force. The revision was anticipated by numerous discussions with Member States' authorities and Stakeholders' organisations. A public consultation was carried out and trade partners were notified through the World Trade Organisation. The European Food Safety Authority (EFSA) was requested to provide scientific opinions on food-borne hazards to be addressed by the revised meat inspection for the different animal species. These opinions were published between 2011 and 2013. From a public health perspective, the EFSA opinions identified *Salmonella*, VTEC and *Campylobacter* as the main hazards to be addressed. Recommendations were made to reduce or even abandon palpation and incisions, since these techniques cannot detect these hazards, while they can cause cross-contamination. Sampling and analysis for these hazards, and an integrated approach, taking into account data from the holding of provenance, were proposed. From the animal perspective, including TB and brucellosis control, the EFSA opinions recognised the strongly reduced occurrence due to control programs, but highlighted that meat inspection by palpation and incisions was the only way to keep monitoring these hazards in certain conditions. The revised meat inspection looked for a balance between the public and animal health recommendations, taking into account the experience made with trade partners after the 2013 revision of pig meat inspection (visual inspection only). The revised meat inspection attributed a more important role to the farm veterinarian in the food chain information, creating a more integrated approach. Incisions and palpations were reduced and targeted to carcasses essential to ensure the monitoring of animal diseases. The possibility of having post-mortem inspection only on a representative sample of carcasses of a poultry batch triggered the most reaction of certain stakeholders, notably Members of Parliament and the press. Implementing Regulation (EU) 2019/627 allows for possible future amendments after due consideration of scientific and technological developments. Pilot projects, limited in time and extent, are allowed in order to evaluate alternative practical arrangements for the performance of official controls on the production of meat. New developments and results of pilot projects can only be generally applied after a favourable opinion of Member States and adoption by the Commission.

Risk-based meat inspection in the context of the agriculture transformation strategy of the Food and Agriculture Organization of the United Nations (FAO)

Blaise Ouattara[1]

[1]Food and Agriculture Organization of the United Nations (FAO), Regional Office for Africa (RAF)

Agricultural transformation is assumed to have significant impact on poverty reduction. The vision in the transformation strategy is to achieve hunger-free populations through an agricultural sector that drives income growth, accelerates achievement of food and nutritional security, generates employment and transforms Africa into a leading player in global food markets to grow wealth for millions of farmers. In traditional meat inspection, inspectors make judgments about disease conditions and abnormalities on the basis of what they can see, feel and smell, a process known as organoleptic inspection. These practices are not suitable for detecting and controlling many frequently occurring meat-borne hazards such as *Campylobacter*, *Salmonella*, and shiga toxin-producing *Escherichia coli* (STEC), and they are not cost-effective. There is a need to adapt and modernise meat inspection practices so a more risk-based approach is adopted, where decisions, standards and control activities are based on specific knowledge of the risks. This presentation discusses the importance of modernisation of meat inspection globally and in the context of Low and Medium Income Countries (LMICs). Building on a mapping and profiling study of slaughter establishments undertaken by FAO in Ghana, the author presents the challenges (weaknesses of regulatory frameworks, laboratory systems, coordination of the management of food safety activities etc.) and opportunities for the development of modern meat inspection systems in Africa, including partnership with the private sector. The presentation also introduces technical guidance and tools (e.g. Principles of Risk-Based Meat Inspection and their Applications, Food Control Systems Assessment Tool) and FAO's views on the development of strong meat inspection systems and insurance of fair trade in the context of Agriculture Transformation strategy and the Africa Continental Free Trade Area (AfCFTA). The success of meat inspection systems depends on the capability and the willingness to move to a risk-based approach.

ABSTRACTS OF ORAL PRESENTATIONS

European risk-based meat safety assurance system - The role of RIBMINS

Bojan Blagojevic[1], Truls Nesbakken[2], Ole Alvseike[3], Ivar Vågsholm[4], Dragan Antic[5], Sophia Johler[6], Kurt Houf[7], Diana Meemken[8], Ivan Nastasijevic[9], Madalena Vieira Pinto[10], Boris Antunovic[11], Lis Alban[12]

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The traditional meat safety system has significantly contributed to public health protection through the last century. However, it has also been recognised that this system suffers many flaws – the main being its limited ability to control the current meat-borne hazards. The process of its evolution to the modern, risk-based system is driven by science as well as political and stakeholders' interests. More than a decade ago, the European Commission requested that the European Food Safety Authority evaluate meat inspection in a public health context, prioritise meat-borne hazards and propose a generic framework of a new, risk-based meat safety assurance system. The proposed system is longitudinally integrated and incorporates official meat inspection with producers' food safety management systems into a coherent whole. The system's practical implementation is expected to be a slow and careful process followed by thorough development, fine-tuning, and testing of practical feasibility and general impacts. The initial implementation of the system has recently started as a direct result of changes of relevant legislation in the European Union. Many challenges have emerged and several threats are foreseen. Further progress that will lead to the full implementation is dependent on intensive research to collect data and fill knowledge gaps as well as on training the new system's participants. Strengthening the links between scientists, competent authorities and food business operators is a cornerstone of functionality of the new system. Therefore, recently, a network of representatives of these groups has been established through the COST Action RIBMINS, "Risk-based meat inspection and integrated meat safety assurance". The network aims to combine and strengthen European-wide research efforts on modern meat safety controls, and thus, help implementation of the risk-based meat safety assurance system across Europe.

From traditional to visual-only pig meat inspection in Denmark – A journey

Lis Alban[1,2], Jesper Valentin Petersen[1], Anne Kristine Bækbo[1], Tanja Østergaard Pedersen[3], Amanda Brinch Kruse[2], Goncalo Pacheco[4], Marianne Halberg Larsen[2]

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This talk summarises the process related to modernising pig meat inspection in Denmark between 2006 and 2020. In those years, a series of national risk assessments and epidemiological investigations were undertaken to elucidate the effect of changing from traditional to visual-only inspection (VOI). Due to trade requirements, the work was undertaken in a stepwise approach. Initially, the focus was on understanding what would be missed, how often, and what the consequences might be, if incisions and palpations were no longer routinely made. Next, the focus was put on the microbiological burden of pigs previously suffering from generalised diseases. The work was undertaken in collaboration with academia, industry, and veterinary authorities. We chose to use the risk assessment approach developed by the OIE (Office International des Epizooties, now World Organisation for Animal Health), which involves five steps: hazard identification, release assessment, exposure assessment, consequence assessment, and risk estimation. Samples were collected from abattoirs and subjected to laboratory investigation to inform the results of the assessments. Furthermore, slaughterhouse statistics, literature, and expert opinions were collected and used. It was concluded that VOI could safely replace traditional inspection, although some cases of endocarditis and embolic pneumonia would be missed. Today in Denmark, VOI is in place for indoor-raised finishing pigs. Use of risk assessment following the OIE approach combined with in-country, up-to-date data was shown to be a transparent approach to illustrate the effect of a given change on food safety, animal health and animal welfare. This transparency ensured acceptance of equivalence on export markets as well as acceptance among consumers and people involved in meat inspection. Hereby, targeted, cost-effective and safe procedures were implemented step-by-step, leading to a reduction in food waste and improving the working environment. Finally, our work showed that for lesions related to prior septicaemia, targeted focus on the predilection sites for abscesses during inspection and cutting was sufficient to detect and handle abscesses.

Modernisation of meat inspection in the Swedish context

Torbjörn Axelsson [1], Arja Helena Kautto[1,2]

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The government of Sweden has granted the Swedish Food Agency (SFA) an extra mandate to modernise official controls at slaughterhouses (SH) and game handling establishments (GHE) during the period of 2018 to 2020. The purposes of the project are to enhance the efficiency and reduce the costs of the meat inspection services, strengthen communication with business operators and develop new control methods, e.g. using modern technology. Several different activities have been conducted after preliminary analysis of strengths and weaknesses as well as flexibility in Union legislation in meat inspection during 2018.

Part 1. A new model for management of the meat inspection services was developed and implemented. The model provides better conditions for follow-up of operations, for internal comparisons and a better basis for taking measures that improve the controls.

Part 2. Food business operators were asked in two separate surveys on their views on the official controls performed in SH/GHE. A majority of the companies (70%) stated that the dialogue with SFA control staff is good or very good. The larger companies, on the other hand, were less satisfied with the equivalency of official controls. The development activities were, therefore, changed from strengthening communication to increasing the equivalence of assessments made in control.

Part 3. The post mortem inspection (PMI) procedures for bovine animals were simplified and incisions of the masseters were made no longer compulsory in Sweden. The new approach was justified by risk analysis based on reporting data. Efficacy and effectiveness of the ability of this method to control bovine cysticercosis was followed up.

Part 4. SFA are developing new control methods for poultry meat where only a representative sample of poultry from each flock undergoes ante mortem inspection (AMI) and PMI and where food business operators have a system in place to detect and separate birds with abnormalities, contamination or defects.

Part 5. A method for remote PMI using digital audio/video transmission was tested and evaluated by the Swedish University of Agricultural Sciences. The study showed the reliability of remote PMI with the technology used was about as good as on-site inspection. Remote PMI did not appear to affect the probability of detecting findings and no obvious negative consequences for food safety were found.

Part 6. A feasibility study was conducted by Research Institutes of Sweden to investigate the possibilities of using imaging diagnostics for the control of meat. The study showed an automated inspection system for the back of the pig is on the market. A prototype system exists that finds defects on tails and ears, indicating animal welfare problems. The study showed there is potential to develop automated systems that detect swollen joint, abscesses, etc.

The results of the whole modernisation project will be evaluated in 2022.

Level of implementation of new meat inspection systems in 26 European countries

Boris Antunović[1], Bojan Blagojević[2], Ivar Vågsholm[3], Milen Georgiev[4], Diana Meemken[5], Ole Alvseike[6], Sophia Johler[7], Madalena Vieira-Pinto[8], Claudia Guldimann[7], Lis Alban[9]

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Meat inspection in the European Union (EU) is currently undergoing modernisation to reflect the improvement of livestock health and the advancement of science in microbiology and meat safety. The switch follows EFSA's recommendations and the resulting changes in the EU legislation adopted between 2014 and 2019. The switch partially replaces the traditional meat inspection with elements of meat safety assurance. However, the practical implementation of the new system is a complex process that involves fine tuning, feasibility and impact testing followed by development of individual guidelines by the EU Member States and other countries following the updated EU legislation. A comprehensive survey using an in-depth questionnaire was conducted in May-June 2020. Relevant stakeholders in 19 EU member countries and 7 other European countries addressed questions related to the status for the modernisation of meat inspection. The results reveal the European-wide state-of-the-art and challenges for the implementation. The results show substantial variation in status between countries and that the transition process is still ongoing in the different sectors. Indoor raised pigs were identified as the animal population for which the new inspection system appears to be most comprehensively implemented. The level of stakeholders' (central competent authorities, meat inspectors and food business operators) personal confidence with the new meat inspection system varies substantially between the countries. Depending on the country, the new system was reported to require more, the same, or less workload related to inspection of the individual animal compared to the traditional system. However, only few of the surveyed countries had evaluated the efficiency of the new meat inspection system. Trade agreements, inadequate food chain information system, resistance from meat inspectors and costs of implementation constituted the main barriers to implementation of the new meat inspection system. The survey presents a SWOT analysis of the new and the traditional inspection systems, as well as reported challenges related to the current COVID-19 pandemic. The presentation will, furthermore, discuss the limitations of the data and the implications of the findings.

Animal welfare at pig abattoirs: Identifying general critical control points in animal welfare during transport and slaughter and possibilities to improve abattoir staff training

Rudi Isbrandt[1], Nina Langkabel[1], Veronica Duckwitz[3], Christa Thöne-Reineke[2], Mechthild Ladwig-Wiegard[2], Svea Nicolaisen[2], Harm Kuper[4], Marcus Doherr[3], Jörg Altemeier[5], Diana Meemken[1]

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Despite the statutory necessary proof of expertise by certificate, there are still different levels of knowledge in the meat industry, especially in the field of animal welfare. The joint project "Development of target group oriented e-learning training courses to improve animal welfare during transport and slaughter of cattle and pigs" (acronym: eSchulTS2*), with the aim of sustainably improving animal welfare by developing e-learning courses, is funded by the German Federal Ministry of Food and Agriculture. The research team, consisting of three different institutes of the Department of Veterinary Medicine as well as one institute of the Department of Education and Psychology, both Freie Universität Berlin, collaborates closely with a partner of the German meat industry. This collaboration should enhance and standardise teaching and the expertise of people handling animals during transport and slaughter. The developed e-learning materials for the different target groups, which include animal carriers, abattoir staff and animal welfare officers, will be created and provided across slaughterhouses throughout Germany and in different languages. It is also important to consider the possible influence of different socio-economic backgrounds. The modular learning materials for animal welfare-friendly handling of pigs and cattle during transport and slaughter will be the basis for uniform training in German slaughterhouses, leading to a higher and more standardised level of expertise among the people involved in transport and slaughter. Within the project, the Working Group Meat Hygiene will focus on pigs. First, a Systematic Review will be performed to identify general critical control points in animal welfare in the pig production line from transport to slaughter. The results will be integrated in a Delphi survey including experts from different research areas and industry. Here, we will present the overall idea of the eSchulTS2-project and the status of the scientific work.

Flock uniformity: a poultry welfare indicator to be used at slaughterhouse?

Cândido Saraiva[1], Madalena Vieira-Pinto[1,2]

[1]Department of Veterinary Science, UTAD, Portugal; [2]CECAV-Animal and Veterinary Research Centre, UTAD, Portugal

Directive 2007/43/CE establishes the system for assessing the welfare of poultry at the slaughterhouse level, which consists of a systematic assessment of welfare parameters by the slaughterhouse's official veterinarian (OV). In Portugal, those parameters include mortality rate on the farm and during transport to the slaughterhouse, as well as post mortem results such as footpad dermatitis. Nevertheless, the increasing importance of this topic has led to a dynamic search for novel welfare indicators such as flock uniformity. Reduced animal welfare can be indicated by poor flock uniformity due to either general housing or management problems, or bird health problems. For that reason, the aim of this study was to investigate the usefulness of the parameter "flock uniformity" (FU) as an indicator of animal welfare to be used during slaughter of commercial broiler flocks. For that, a total of 26 randomly selected mixed-sex Ross 308 broiler flocks were studied. All flocks were raised under similar farm management systems and had medium age of slaughter of 35 days. To study the uniformity, 10% of each batch was observed and categorised after stunning at the slaughterhouse, using the following scores based on % of small animals observed: score 1 ([0 -2.5%[; high uniformity); score 2 ([2.5-5%[; normal uniformity); score 3 ([5-7.5%[; bad uniformity); score 4 (≥7.5%; no uniformity). Additionally, the following percentages were collected for each flock: mortality in transport, total condemnation (%) and total condemnation due to disease only. The results showed that poorer uniformity was highly associated with increased rejection level (p= 0.002) and increased rejections caused by disease (p = 0.001). This highlights the potential use of this parameter as an animal welfare indicator and also as a criterion to be used under a risk-based meat inspection approach: The worse the flock uniformity, the more time the OV must dedicate to the post mortem inspection of that flock.

Staphylococcus aureus and methicillin-resistant *Staphylococcus aureus* (MRSA) in Greek dairy farms: A One Health perspective

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Staphylococcus aureus is considered the third most common food-borne pathogen that causes food poisoning worldwide. Methicillin-resistant *S. aureus* (MRSA) is a serious public-health concern and it has been demonstrated that besides direct contact with infected animals, the handling and consumption of animal origin-food contaminated with MRSA could lead to the pathogen transmission to humans. In this study, the prevalence and genetic characteristics of *S. aureus* and MRSA were investigated in animals and farm personnel on dairy farms in Northern Greece. A total of 571 samples (farmers: 109, cows: 124, sheep: 215, goats: 123) from 64 dairy farms were collected from three geographical locations of Northern Greece and examined for the presence of *S. aureus* according to ISO 6888-1 (ISO 1999) method. Antimicrobial susceptibility testing of the isolates was performed towards 14 antimicrobials using CLSI guidelines. All phenotypically confirmed MRSA isolates were tested for the presence of *mec*A, *mec*C, Pandon-Valentine Leucocidin (*PVL*) and the *sea-see* genes that encode for the "classic" staphylococcal enterotoxins, and they were also characterised via *spa* typing. The overall *S. aureus* isolation frequency was 56% while low rates of antimicrobial resistance were found. Nineteen samples (3.3%) both from employees (10/109) and animals (9/462) were confirmed as MRSA-positive based on their resistance to oxacillin. Nearly all MRSA isolates (16 out of 19) carried the *mec*A gene, while the *mec*C and *PVL* genes were not detected; 94.7% of them carried one or more enterotoxin-coding genes, with *sec* being most prevalent. Nine *spa* types were identified: t012, t034, t127, t192, t253, t1773, t3536, t4038 and t13336, with t127 being the most prevalent. *Spa* type t034 (livestock associated MRSA CC398) was isolated for the first time from livestock (goat) in Greece. The results of this study showed that animal farms could contribute to the dissemination of MRSA strains (including enterotoxinogenic ones) in the community. Moreover, the fact that MRSA isolates originated from both human and animal sources indicates the importance of the One Health approach in the prevention and control of *S. aureus* infections.

Monitoring of microbiological parameters in pig carcasses in some slaughterhouses in Albania

Bizena Bijo[1], Renis Maçi[2], Egon Andoni[1], Fatmira Shehu[1]

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In Albania, due to the lack of monitoring plans, data on the microbiological quality of pig carcasses in slaughterhouses are lacking. Pork can be contaminated during slaughter by intestinal contents, but also by the use of unclean equipment and careless handling. The pig slaughter and dressing process should be constantly monitored for the possibility of contamination, especially in those steps where control is lost or minimised. In order to investigate the current condition, nine slaughterhouses where the slaughter of pigs was carried out were monitored for three consecutive years (2016-2018). Over three years, we collected 150 samples from pig carcasses and tested them for some of the microbiological parameters: *Total Bacterial Count (TBC), Enterobacteriaceae, Escherichia coli* and *Salmonella* spp. Sampling of pig carcass was performed immediately after removal of internal organs and before the cooling process. The samples were collected with excision technique in five anatomical positions (back, jaw, neck, chest and outer ham), and pooled together. In the case of *Enterobacteriaceae* and *TBC* we received a minimum of five carcasses/day and monitored throughout the week. In the case of *Salmonella* we judged for the presence of *Salmonella spp.* by taking five samples per day/10 cycles in a row. The samples were collected in sterile bags and sent to the Laboratory (FSVI) in refrigerated containers (0-4°C). Validated and accredited standard methods complying with the legislation in force were used. Enumeration of *Enterobacteriaceae* (ISO 21528-2) and detection of *Salmonella spp.* (part one of ISO 6579) were conducted. The results were statistically analysed based on prevalence, and the arithmetic means of the daily counts were expressed in $\log_{10}$. For the pig carcasses, *TBC, Enterobacteriaceae* and *E. coli* were detected in 100% of cases (150/150), while *Salmonella spp.* was detected in 6.3% of cases (5/75). Out of a total of 150 carcass monitoring samples over three years, the average *TBC* and *Enterobacteriaceae* count was 4.5 log CFU/cm^2 and 2.9 log CFU/cm^2, respectively, while the average count of 2.0 log CFU/cm^2 was calculated for the *E. coli* indicator. The most problematic years were 2016 and 2017, with the highest average *TBC* counts, respectively, 5.0 log CFU/cm^2 and 4.6 log CFU/cm^2. In 100% of carcasses (150/150), *Enterobacteriaceae* counts were higher than those of *E. coli.*

Meta-analysis of the efficacy of cattle hide interventions to reduce microbiological contamination in beef

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Interventions at abattoir level are considered necessary to control microbiological hazards and therefore, constitute an essential and integral part of meat safety assurance systems. Cattle hide interventions can be seen as a 'proactive' approach in dealing with the sources of beef carcass contamination. A systematic review and meta-analysis of literature investigating the efficacy of processing interventions to control microbiological contamination in beef was performed. A total of 266 relevant studies were identified, with 113 (42.5%) judged to be at 'low' risk of bias, including four on hide cleanliness assessment and seven on hide interventions where extractable data were available for meta-analysis. The summary effects from a random-effect meta-analysis model show a consistent reduction for all indicator microorganisms (aerobic colony counts (ACC), *Enterobacteriaceae* counts (EBC) and generic *E. coli*) on hides and resulting carcasses, when clean cattle are compared with dirty cattle. Least-squares mean reductions (log CFU/cm^2) on carcass surfaces were 0.9 (95% confidence interval (CI): 0.54-1.26) for ACC, 0.71 (0.36-1.05) for EBC and 0.75 (0.65-0.85, only one study) for *E. coli*. There was an insufficient number of hide intervention studies on hide clipping, bacteriophage treatment and some chemical washes to draw firm conclusions on their efficacy. The meta-regression effect revealed that hide water wash may have some limited protective effect in reducing STEC prevalence on hides, although the high heterogeneity found in the summary effects indicates that the intervention results differ substantially (relative risk (RR) 0.85; 95% CI: 0.66-1.09). The mean reduction effect in reducing levels of aerobic bacteria on hides was also low, 0.6 log CFU/100 cm^2, questioning the usefulness of hide water wash as a stand-alone intervention. Studies investigating microbial immobilisation treatment of cattle hides (shellac spray coating) showed the mean reduction effect (log CFU/cm^2) on resulting beef carcasses (reduction-in-transfer) was 1.07 (95% CI: 0.29-2.43) for ACC and 0.59 (1.05-2.22) for EBC. When six controlled trials (conducted under commercial abattoir conditions), investigating shellac spray hide coating and chemical spray washes with cetylpyridinium chloride, sanitiser and sodium hydroxide, were plotted together, they showed the reduction effect on beef carcasses (log CFU/cm^2) of 1.09 (95% CI: 0.65-1.53) for ACC and 0.81 (0.28-1.35) for EBC. The results indicate that cattle hide interventions are efficacious in controlling microbial contamination on beef carcasses. However, the high heterogeneity found in the summary effects indicates that the intervention results differ substantially and more research is needed.

Hygiene performance rating — An auditing scheme for evaluation of slaughter hygiene and a contribution to comply with regulations

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The Hygiene Performance Rating (HPR) scheme was developed by Animalia in Norway. This auditing tool for assessment of slaughter hygiene has been used in Norwegian abattoirs for the last 10 years. The HPR scheme visually evaluates and documents each operation on the slaughter line, assessing the factors that can affect the slaughter hygiene. The protocol is based on a systematic evaluation of general hygienic practices of each operation, such as the operators' hygienic behaviour and risk handling of the carcasses, along with routines and management. The scores are registered in a web-based application. The observations are given a score from 1 to 3, where 1 means "acceptable", 2 = "potential for improvement", and 3 = "not acceptable". Scores for each position are multiplied by a weight factor for hygienic impact and risk (1, 3, 6 or 12) and economic consequences (1 or 2) describing whether the necessary improvement depends on a significant investment (1) or if it is a cheap quick-fix (2), and calculated as a percentage where 100% is perfect hygiene. Presentation of results for the involved parties, including operators, is a crucial part of the implementation of the HPR scheme. HACCP and Good Hygiene Practise concepts were introduced in Codex Alimentarius' standards and implemented in European legislation from the 1990s. Validation is a basic element of HACCP and shall "obtain evidence that the elements of the HACCP plan are effective". Furthermore, verification is "the application of methods, procedures, tests and other evaluations, in addition to monitoring to determine compliance with the HACCP plan" and is also the 6th principle of HACCP. In the meat sector, microbiological sampling is the central objective method for verification of hygiene. A study performed in 20 European slaughter lines evaluated the HPR scheme by comparing it with microbiological testing of carcasses slaughtered the same day as the audit was done. A close relationship was found between the total HPR score and the *Enterobacteriaceae* and *E. coli* counts of the carcasses. This high correlation suggests that HPR could be a useful proxy measure for improving slaughter hygiene and risk management.

Comparison of sampling methods – Need for clearer guidelines for microbiological quantification on broiler carcasses

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For supplying wholesome meat for consumers, the EU has set regulatory limits for microbiological routine testing of carcasses or products thereof in "Microbiological criteria for foodstuffs" (Regulation 2073/2005). This testing monitors and controls the hygienic standards in the slaughter process where the meat industry uses the HACCP approach and Good Hygienic Practice, while competent authorities use the testing to verify food business operators' own food safety management systems. The microbiological criteria set limits for selected pathogens and indicator bacteria. This is the case for cattle, sheep and pig carcasses. However, for broiler carcasses, no acceptable limits for indicator bacteria are set, but are in place only for pathogens. It is necessary to provide clearer guidelines for broiler carcass sampling, for a more uniform approach when quantifying carcass contamination. The present study was conducted in 2019 in a commercial broiler abattoir to compare the efficiency of four sampling methods for quantification of bacterial contamination of broiler carcasses at slaughter. Samples (n=100) were collected from naturally contaminated carcasses. Sampling methods were: whole-carcass rinse (WCR) in 200 mL liquid, 10 g of neck skin and breast skin, respectively, and gauze cloth swabs (3 sites x 100 cm^2). The samples were analysed for total plate count, *Enterobacteriaceae,* and *E. coli* using Petrifilm. The results were converted into log cfu per cm^2. The recoveries of *Enterobacteriaceae* and *E. coli* were highest from samples collected by WCR, followed by neck-skin (recovered 80-100 % of WCR), then breast-skin (recovered 50-65 % of WCR), and finally swabbing (recovered 40-50 % of WCR). In conclusion, the WCR sampling method provides the best reflection of the extent of carcass contamination. This study contributes to the knowledge regarding choice of sampling method and expected recovery of microbiological contamination. Further, the ability to convert results obtained by different sampling methods would ease the comparison of microbiological quantification. Hence, the risk of incorrect conclusions regarding microbiological contamination in different systems or countries could be reduced. In poultry meat inspection, implementing sampling methods that better recover the true bacterial contamination on carcasses can contribute to increased food safety for consumers, as measures will be implemented according to legislation.

The main causes for condemnations of broiler carcasses at meat inspection in Finland and the variation of their prevalence

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Meat inspection data can be used as a source of information about health and welfare problems of broilers. The effective use of these data demands comparability of meat inspection between slaughterhouses. Differences in the organisation of the meat inspection and the collection of data in slaughterhouses can weaken the usability of these data. In this study, the monthly collected meat inspection data (from 2015 to 2019) from four (A—D) Finnish broiler slaughterhouses, which slaughter the majority of broilers in Finland (99% in 2019), were received from the Finnish Food Authority. All flocks were *Salmonella* negative and they were reared conventionally indoors without antibiotics. This study aimed to elucidate the significance of these data for assessing broilers' health and welfare and to assess the differences between the slaughterhouses' condemnation rates. The prevalence of the condemnations of whole carcasses due to findings of ascites, emaciation, dermatitis, cellulitis, bruises, abdominal cavity disorders (such as peritonitis, focal hepatic necrosis or yolk on abdominal cavity) and other reasons (excluding processing failures) were calculated for each slaughterhouse using Microsoft® Excel® for Office 365 MSO. The annual differences in prevalence of these condemnations between the slaughterhouses were tested with the Independent-Samples Kruskal-Wallis Test, and pair-wise tests were done using Dunn's post hoc test with the Bonferroni correction in IBM SPSS Statistics 25. Altogether, the annual total prevalence of the condemnations of whole carcasses was 1.39%—2.20% in Finland from 2015 to 2019. Ascites (0.32%—0.43%), cellulitis (0.31%—1.02%) and abdominal cavity disorders (0.20%—0.32%) were the most common causes each year. The prevalence of ascites differed significantly between the slaughterhouses (P=0.005). Slaughterhouse pairs BC and CD had significant differences. Cellulitis condemnations did not differ between the slaughterhouses, but the prevalence of cellulitis decreased between 2015 and 2019, and the variation between the slaughterhouses dropped sharply during these years. The prevalence of the abdominal cavity disorders changed only little. Ascites and cellulitis were the most important condemnation causes in 2015—2019. Both affect the health and welfare of broilers and are detected better at meat inspection than on farm. One reason for differences between the slaughterhouses could be the different inspection practices, and that warrants further investigation. The high prevalence of cellulitis in 2015—2016 was due to the colibacillosis outbreak among broilers.

Classification scheme for acute/chronic vertebral osteomyelitis to be applied during post-mortem inspection of swine carcasses – A suggestion

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During meat inspection, it is of major relevance to classify a lesion into acute or chronic in order to properly evaluate if meat can be declared fit or unfit for human consumption, since acute cases are more related to generalised disease, like septicaemia. Understanding this importance, a classification scheme using macroscopic characteristics of gross pathological findings was created to support Vertebral Osteomyelitis (VO) classification, the main cause of condemnation of slaughtered pigs in Portugal. The following objective macroscopic characteristics were used: Acute cases: Shiny and moist lesions with, sometimes, congested areas. Evident bone destruction, not circumscribed by adjacent remodelling tissue; presence of fluid purulent exudate; Chronic cases: Moderate bone destruction, entirely circumscribed by remodelling tissue; thickened exudate. No evidence of congested areas. To evaluate the effectiveness of this classification, each VO lesion was submitted to a histopathological analysis considered as the golden standard. For that, a bone column fragment with the VO lesion was cut and stored in a container with 10% neutral-buffered formaldehyde for further evaluation. At the laboratory, after decalcification, specimens were routinely processed for histological examination, embedded in paraffin wax, sectioned into 3 µm slices and stained with haematoxylin-eosin. The classification scheme was applied to 40 VO cases identified during post-mortem inspection in one Portuguese slaughterhouse. From those, 20 were macroscopically classified as chronic and 20 as acute. Cohen's kappa coefficient (κ = 0.80; $P<0.001$) revealed a substantial agreement between the two classification procedures (macroscopic/histopathology). Hence, the classification scheme is a reliable proposal to be used during post-mortem inspection, contributing to harmonisation of criteria concerning VO classification and helping to promote food safety and protect public health as demanded by the EU Meat Inspection Implementing Regulation.

Assessing animal welfare at the slaughterhouse using Animal-Based Measures in docked and undocked heavy pigs

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The use of Animal-Based Measures (ABMs) for monitoring pig health and welfare at the slaughterhouse has increased lately. Among ABMs, tail and skin lesions are generally recognised as 'iceberg' indicators of welfare issues in pigs. The aim of this study was to evaluate these ABMs at the slaughterhouse in docked and undocked heavy pigs (~170 kg live weight). The study was carried out in an industrial abattoir located in Northern Italy between January and March 2020. A 5-point scale scoring system was used to assess tail lesions, while a 4-point scale scoring system was applied for skin lesions belonging to two regions: 'caudal' (hind legs and tail) and 'cranial' (remaining area). Presence/absence of ear lesions, vertebral abscesses and swellings at the base of the tail were also recorded. Data were collected from 108 batches coming from 71 farms and for a total of 11 908 pigs, 8 694 of which were docked and 3 214 undocked. The prevalence of tail lesions, skin lesions, ear lesions, vertebral abscesses and swelling at the base of the tail was calculated at batch level. Tail lesion scores were arranged into none (score=0), mild (score=1), moderate (score=2) and severe (score≥3). Differences between the two groups (docked *vs* undocked pigs) were assessed using $\chi 2$ test or Fisher's test. The strength of the pairwise association between tail lesions scores, skin lesions scores, vertebral abscesses and ear lesions was assessed using the Spearman's correlation test. For this test, an overall tail and skin lesion score was calculated for each batch by weighting tail and skin lesion scores. Swelling at the base of the tail was not included due to low prevalence. The prevalence of tail lesions was generally higher in undocked pigs than in docked pigs ($P<0.0001$), while no differences were found for skin lesions. In particular, the prevalences of mild lesions (score =1, 21.7% vs 5.8%, OR: 4.6, 95% CI: 4.1 to 5.2), moderate lesions (score=2, 9.3% vs 0.5%, OR: 11.7, 95% CI: 9.1 to 15.0) and severe tail lesions (score≥3, 2.3% vs 0.4%, OR: 4.2, 95% CI: 3.9 to 8.6) were significantly higher in undocked pigs than in docked pigs ($P<0.0001$). A strong correlation ($r=0.54$, $P<0.001$) between skin lesion scores and ear lesions was found, while a weak correlation ($r=0.37$, $P<0.001$) between tail lesion scores and vertebral abscesses was present. In this study, a difference in the prevalence of mild, moderate and severe tail lesions between undocked and docked pigs was observed. Our findings corroborate the use of skin lesions as a good indicator of welfare issues on farm, supporting the application of schemes based on ABMs at the slaughterhouse to evaluate animal welfare in pigs.

Differences in terminology and frequency of meat inspection lesions in finishing pigs in seven European countries – A pilot study

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In the European Union (EU), meat inspection is up for debate. The objectives of inspection are to ensure food safety, animal health and animal welfare. There is a request for a system that can help to address these objectives in a more valid, feasible and cost-effective way than seen at current. Due to the introduction of visual-only inspection, the need for modernisation is prominent for pigs. One part of the modernisation deals with the coding system in place used to register meat inspection lesions. Although the EU Food Inspection Regulation (EU) 2019/627 applies in all Member States and in other countries following the EU legislation, national coding systems are in place along with associated judgement criteria for when to condemn meat as unfit for human consumption or not. Pig meat inspection data from 2019 from seven European countries – Denmark, Finland, Germany, Italy, Norway, Portugal and Spain – were collected and used to compare terminology and frequencies of lesion codes connected with partial or total condemnation. Hereby, we were able to identify a common top-10 list for the lesion codes leading to partial and total condemnation, respectively. We will subsequently apply a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis to the coding systems. Moreover, we will identify variations in the top-10 list between countries and provide possible reasons behind the differences. Finally, we will compare reasons for unfitness of meat given in the EU Regulation to the national lesion code lists. The current work will subsequently continue with an in-depth collection and analysis of data about the different lesion code systems in place in a higher number of European countries. The work to be done could be used by the individual countries to update their coding system towards a more harmonised system, while respecting the epidemiological situation and the food safety culture in the country, as well as the trade agreements in place.

Innovative Meat Factory Cell concept shows improved hygiene and suggests need for changes in legislation

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Regulation (EU) 2017/625 prescribes high standards of human and animal health, the rational development of the value chains, and increased productivity (preamble 5). When adopting delegated acts, the Commission shall take into account experience gained and scientific and technological developments (Article 16). However, legislation will become outdated mostly in times of rapid technological change, and it is the suppliers' and FBO's role to suggest and demonstrate better solutions. The novel Meat Factory Cell (MFC) approach for pig slaughter and primary cutting introduces changes to conventional meat production and processing. The MFC process results in seven cuts in the abattoir; four limbs, the saddle including head and tail, the viscera including pluck, stomach and intestines, and a cut comprising ribs and belly. MFC deviates from conventional processing in three principal ways: 1) MFC organises the processing work in cells instead of lines, which is in agreement with legislation; 2) MFC combines and merges elements of slaughter and meat primal cutting. This is not in line with legislation because FBOs are not supposed to perform the cutting in abattoirs; 3) MFC "disassembles" the carcass from outside-in, without prior removal of internal organs before removal of most primary cuts. This is not in line with legislation, as evisceration is supposed to be undertaken as soon as possible. However, it has been demonstrated that an intact gastro-intestinal tract removal from pig carcasses is possible in MFC. Furthermore, trials with a non-optimised prototype indicated very good hygienic results (*E. coli*, 2.60 log CFU/cm^2, little variance, N=29). Post mortem meat inspection can also be undertaken holistically, where the entire carcass and organs are presented for the meat inspector including plucks and bowels. Our trials are a practical example showing that future delegated regulations could be more flexible and open to scientific and technical innovation. New approaches by objective targets from functional demands could replace (or complement) detailed descriptions on how the targets are addressed and obtained. The presentation will give a status and progression report from the EU project RoBUTCHER that aims at a fully automated MFC concept.

ABSTRACTS OF POSTER PRESENTATIONS

Occurrence of *Trichinella* spp. in domestic pigs and wild boars in Poland (2016-2019)

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Trichinellosis is a zoonotic meat-borne disease caused by the nematodes of the genus *Trichinella*. Humans and animals can be infected by eating muscle tissue contaminated with live larvae of *Trichinella* spp. The most common source of human infection is the meat of domestic pig and wild boar. The goal of the study was to investigate occurrences and geographical distribution of *Trichinella* spp. infections of wild boars and domestic pigs in Poland in the years 2016-2019. Preferential muscle tissues of domestic pigs and wild boars were investigated by the digestion method, and subsequently detected *Trichinella* spp. larvae were identified at the species level by multiplex PCR. Detected and genetically identified infection cases were geographically mapped using QGIS software. A total of 89,341,610 domestic pigs and 1,080,412 wild boars were tested. We identified 81 *Trichinella spiralis*-positive pigs. In wild boars, 930, 300, and 22 cases of *T. spiralis, Trichinella britovi*, and mixed *T. spiralis*/*T. britovi* infections, respectively, were found. As shown in Figure 1, all *Trichinella*-infected domestic pigs and the majority of infected wild boars were detected in the north and west of the country. The number of infected pigs is decreasing, as the highest percentage of infected pigs was observed in 1992 (0.0033%) and the lowest in 2007 (0.00001%) (in 2019, 0.00004% of pigs were infected). A systematic increase in the number of infected animals was observed in the wild boar population, up from 60 in 2000 to 752 in 2015. The lowest percentage of infected wild boars was observed in 2001 (0.18%) and the highest in 2015 (0.5%). In conclusion, Poland cannot apply for *Trichinella*-free country or region status; however, farms located in the south-east part of Poland may apply for *Trichinella* free holding certification.

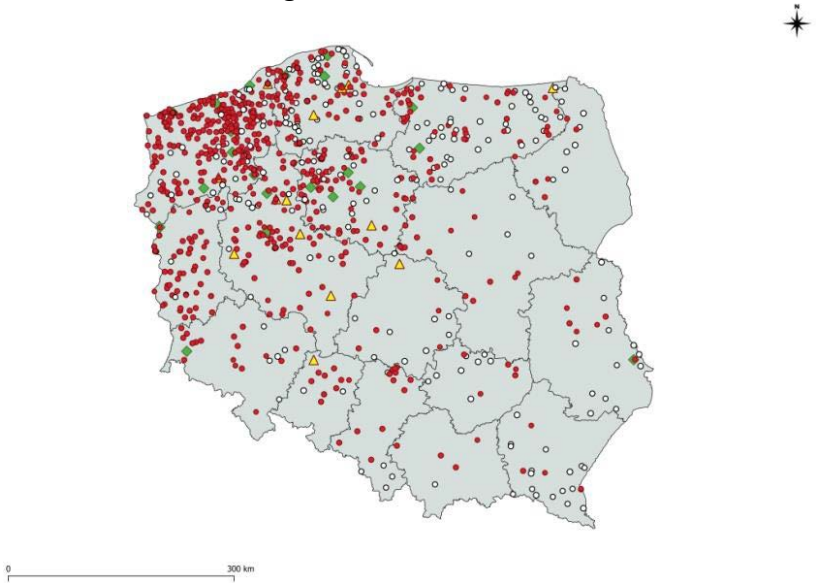

Figure 1. Geographical distribution of *Trichinella* species detected in wild boars and domestic pigs in Poland, 2016-2019. Red points - *T. spiralis*, white - *T. britovi*, green diamond - mixed infections. Yellow triangles represent *T. spiralis* in domestic pigs.

Staphylococcus aureus in abattoir byproducts of pig origin

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Many parts from pig carcass processing are currently not used for human consumption in Switzerland, although they are of great nutritional value. Therefore, data on the occurrence of pathogenic organisms on byproducts is extremely scarce and the prevalence and population structure of *Staphylococcus aureus* on meat processing sidestreams is unknown. Hence, abattoir byproducts of pig origin including ear, forefoot, heart, intestine, liver, rib bone, sternum, bladder, stomach, hind foot and tongue originating from six abattoirs were screened for *S. aureus*. The obtained isolates were investigated by *spa* typing and DNA microarray analysis to reveal their genomic profile and population structure. The prevalence of *S. aureus* was generally low with a mean of 0.08%. In total, 40 *S. aureus* strains were detected and assigned to 12 *spa* types (t015, t1491, t1778, t091, t337, t899, t2922, t7439, t1333, t208, t4049, t034) and seven clonal complexes (CC1, CC7, CC9, CC30, CC45, CC49, CC398). Detected enterotoxin genes included *sea*, *seb*, *sec*, *seh*, *sel* and *egc*, and the encoded toxin genes *seg, sei, sem, sen, seo* and *seu*. None of the isolates harboured genes conferring methicillin resistance, but *blaZ/I/R* genes causing penicillin resistance were frequently found. In addition, strains from CC398 exhibited *tetM* and *tetK,* conferring tetracycline resistance. Similarity calculations based on microarray profiles revealed no association of clonal complexes with particular body parts, but revealed a certain correspondence of clonal complex and originating abattoir.

Is risk categorisation of poultry abattoirs on the basis of the current process hygiene criteria possible?

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Risk categorisation of abattoirs is one of the main components of the new, risk-based poultry meat safety assurance system. Currently, poultry abattoirs are assessed and can be ranked using the process hygiene criteria (PHC), laid down in Regulation EC 2073/2005 and its amendments by which compliance of *Salmonella* spp. (n=50, c=5; m= not detected in 25 g of a pooled sample of neck skin) and *Campylobacter* spp. (n=50, c=15; m=1000 CFU/g) on carcasses after chilling is monitored. The aim of this study was to investigate whether regulatory limits for the two pathogens on broiler carcasses are useful in categorisation of poultry abattoirs into risk groups. Four poultry abattoirs, two industrial (A and B) and two small scale (C and D), were subjects of the study. Fifty samples, comprising neck skins of 150 broiler carcasses per abattoir were tested for *Salmonella* presence (ISO 6579-1:2017) and *Campylobacter* counts (ISO 10272-2:2017), over two working days. Only abattoir C had satisfactory process hygiene (i.e. low risk) regarding both *Salmonella* (2 positive out of 50 pooled samples) and *Campylobacter* (13/50 pooled samples had >1000 CFU/g). Abattoirs A, B and D were unsatisfactory (i.e. high risk) considering criteria for both pathogens (*Salmonella*: A=16, B=19 and D=34 positive out of 50 samples; *Campylobacter*: A=39, B=49 and D=25 out of 50 samples with >1000 CFU/g). Similarly, when two separate working days were considered (25 samples per abattoir), abattoir B showed unsatisfactory results on both days for both pathogens. On the other hand, abattoir A was unsatisfactory for *Salmonella* on day 1 only (14 positive out of 25) but satisfactory on day 2 (2/25), while it was unsatisfactory for *Campylobacter* on both days (14/25 and 25/25 samples had >1000 CFU/g). Conversely, abattoir C was satisfactory for *Salmonella* on both days (2/25 and 0/25 positive) but it was unsatisfactory regarding *Campylobacter* on day 1 (13/25 samples with >1000 CFU/g), while it was satisfactory on day 2 (none of the samples exceeded the limit). Finally, abattoir D was unsatisfactory for *Salmonella* on both days (10/25 and 24/25 positive), but regarding *Campylobacter*, it was unsatisfactory on day 1 (all samples had >1000 CFU/g) and satisfactory on day 2 (all samples were negative). The results indicate that *Salmonella* presence and *Campylobacter* level on carcasses are likely more dependent on sampling day and, thus, on incoming (pre-abattoir) presence or level of pathogens, rather than being associated with an often consistent level of process hygiene. The current PHC does not allow proper risk categorisation of poultry abattoirs; hence, investigation of other means of risk categorisation is necessary.

Cross-sectional study to identify risk factors associated with the presence of *Escherichia coli* in bovine lymph nodes at slaughter

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This research arises from the background of a progressive streamlining of post mortem inspection at the slaughterhouse. For a comprehensive risk assessment, this approach has to consider also the presence of lymph nodes which adhere to the carcass and are, therefore, accidentally destined for consumption. In fact, a potential source of pathogenic bacteria in ground beef is the lymphatic system, specifically the lymph nodes. The objective of this study was to determine the prevalence of *Escherichia coli* in bovine lymph nodes. A total of 597 subiliac (precrural) lymph nodes were obtained from 597 cattle carcasses from six commercial processing plants in central Italy and screened for *E. coli* by culture and for stx1, stx2, *eaeA* and *hlyA* genes by PCR. Altogether 204/597 (34.2%) carcasses were positive for *E. coli*. Fifty-nine of these isolates carried stx1 or stx2 genes (9.9% of the cattle sampled). A multivariable analysis identified "age" as the factor most closely related to the isolation of *E. coli (*OR = 1.122, P=0.0034), with a higher probability of *E. coli*-positive lymph nodes occurring in older animals. The similarity of odds ratio for multiple logistic regression with the simple logistic regression indicated there was little confounding effect of other factors on the relationship between animal age and *E. coli* positivity rate. On the other hand, the simple logistic regression also showed statistically significant differences for "distance" (OR=0.814, P=0.0009), where the longer the journey from farm to abattoir, the lower the probability of *E. coli*-positive lymph nodes, "slaughter", with *E. coli*-positive lymph nodes more frequent in carcasses from casualty slaughter (OR+1.902, P=0.0032), and "diet", where a lower rate of *E. coli*-positive lymph nodes was found in animals fed a forage rich diet (OR+1.919, P=0.3894). The combined analysis of data from the simple and multiple logistic regression analyses along with the data distribution help shed some light on the prevalence of *E. coli* in the subiliac lymph nodes of the 597 cattle analysed. For instance, "age" is a confounding variable for "distance", "slaughter" and "diet": the mean age for animals on a forage rich diet was 1.41 years compared to 3.11 for those fed high grain rations; a high proportion of younger animals came from longer distances, and; the mean age for animals slaughtered by ordinary procedures was 1.86 compared to 6.43 for casualty slaughters. The multivariable analysis of the isolates identified "age", "gender" and "slaughter" as the factors most closely related to PCR positivity for stx1 or stx2, where isolates from females and ordinary slaughter carried these genes more frequently. Other factors, such as "diet", and "distance" were linked to PCR positivity only by the simple logistic regression, indicating a confounding effect. This research underlines the role of lymph nodes as a source of contamination with pathogens for beef and especially ground meat, and focuses the attention on the function of post mortem inspection with a view to modern trends and revisions of procedures.

Slaughterhouse monitoring of tail-docking and tail biting lesions of pigs in Portugal

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The European legislation states that before docking pigs' tails, other measures that prevent tail biting must be implemented, and, therefore, a thorough risk analysis must be performed. Consequently, there is increasing interest in recording tail damage in pigs at slaughter to identify problem farms for advisory purposes, but also for benchmarking as part of systematic monitoring of animal welfare. The goals of this study were to (1) assess tail-docking and tail biting in slaughter pigs and (2) evaluate the association of tail lesions with meat inspection findings. The study was carried out over 24 non-consecutive days at four pig slaughterhouses in the north of Portugal, between October and December 2019. Data were collected during checks on food chain information and at ante- and post- mortem meat inspection. A total of 10146 pigs was screened: 4090 weaners (132 batches from 62 farms) and 6056 fattening pigs (64 batches from 43 farms). The majority of the batches analysed were classified as tail-docked (88.3%, 173 batches). Most weaner batches presented docked tail (82.6%, 109 batches) and all 64 batches of fattening pig were docked. Tail lesions were scored according to a 3-level scale with levels representing absence (0), mild (1), and severe (2) lesions. In post-mortem inspection, most pig carcasses (84.4%) were assigned to 0 on the scale (absence of tail lesions). Mild to moderate tail lesions (12.9%) were more frequent than severe ones (2.7%). Tail lesions, both mild and severe, were more prevalent in weaners (13.1% 3.5%, respectively) than in fattening pigs (12.7% and 2.1%, respectively). A total of 169 (1.7%) carcasses were condemned during post-mortem inspection with the prevalence being higher in weaners (3.3%) than in fattening pigs (0.6%). The most frequent causes were poor body condition (31.4%), arthritis/polyarthritis (28.4%), peritonitis (20.1%) with purulent arthritis/polyarthritis (33.3%) and purulent osteitis/osteomyelitis (38.2%), which were the predominant causes of condemnation in weaner and fattening pig carcasses, respectively. In our study, no association between tail lesions and post-mortem condemnations was observed. Therefore, there was no reason to conclude that tail biting increases the risk of carcass condemnation. Further research with increased sample size is needed. Recording information on moderate and severe tail lesions at the slaughterhouse is useful to gain information and further knowledge about general herd health and to establish adapted welfare management plans.

Tail biting in pigs: comparison of tail lesions at the farm and abattoir level

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Based on Directive 2008/120/CE, many countries implemented a monitoring plan to prevent tail biting and reduce tail docking at farm and/or abattoir level. The purpose of this study was to evaluate the effectiveness of a tail injury monitoring system at the abattoir in docked (DA) and undocked animals (UA). For that, tail lesions in individually identified DA (n=470) and UA (n=440) were recorded before transportation to slaughter and during post-mortem inspection. Based on European legislation, no animal was transported with a visible "open" injury. For that, tails were scored as level 0 (no evidence of tail biting), S1 (scarred lesions without loss of the tail) or S2 (scarred lesions with partial or total loss of the tail). At the abattoir, animals scored as 0 and S1 were analysed as one group, due to the difficulty of classifying both lesions with 100% precision. On farm, tail biting was only observed (311/440, 70.7%) in the UA that were classified before transport to slaughter as S1 (N=78) and S2 (N=233). At abattoir, 25 of the 440 UA presented other tail injuries that could have occurred during transportation or in the abattoir holding pens. In the remaining 415 animals, it was possible to evaluate the agreement between the classification made on the farm and that carried out at the abattoir. Of the 191 animals with tails classified as 0 or S1 on the farm, 110 (57.6%) were classified with the equivalent score at the abattoir. The remaining 81 animals were classified as S2 due to apparent partial loss of the tail (false positive). From the 224 UA classified as S2 on the farm, 200 (89.3%) were classified with the same score at the abattoir. In the remaining 24 animals (false-negative), the partial loss of the tail was not detected during post-mortem inspection. The results point out the difficulty of correctly evaluating the variability of the size of long tails of the undocked animals in order to properly identify partial loss of the tail, which was the more frequent score (S2) found in this study and the most relevant in terms of animal welfare. For that reason, further studies should be developed to fill this gap.

Gross lesions detected during post-mortem inspection of laying hens: the role of Microscopic Observation

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We have investigated the health condition of laying hens on the basis of patho-anatomic findings obtained during post-mortem inspection. Nineteen flocks from different farms were slaughtered at ages ranging from 483 to 845 days of life. During the post-mortem inspection, 484,053 hens were observed at the slaughter-line. The percentages and causes of total condemnation were recorded. Additionally, different lesions were collected for histopathological (HP) examination and processed by conventional methods for light microscopic observation. The paraffin preparations were stained with hematoxylin and eosin. The overall percentage of total condemnation was 2.9% (14,104/484,053). From those, the main causes of condemnation included: peritonitis (39.7%), salpingitis (25.2%), cachexia (17.8%) and other reproductive pathology (ovary and oviduct) disorders (14.3%). Among the samples collected for histopathological analysis was a lesion 2cm diameter at its largest dimension, with several yellow nodules and disseminated by the oviduct, mesentery, intestine, pancreas and spleen. The differential macroscopic diagnosis was coligranuloma, tuberculosis granuloma or carcinoma of the oviduct. Microscopic analysis revealed a pancreatic infiltrating growth tumour, resulting from the proliferation of acidophilic cytoplasm cells with evident zymogen granules, which were arranged in groups with some small lumina. The diagnosis was Acinar cell carcinoma, an unusual lesion detected in hens. This discovery reinforces the importance of using microscopic observation to support meat inspection in order to have a correct diagnosis and serve as an alarm for the production chain.

Gut microbial ecology during *Campylobacter* infection in chickens: a description of community changes via metataxonomic characterisation

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Campylobacter is the most important foodborne zoonotic agent in the EU, with chicken being the principal reservoir for human infection. Control measures at farm level have not been effective in reducing *Campylobacter* prevalence so far, even though they may be effective in reducing the bacteria load of carcasses at the slaughterhouse and eventually human infections. Deeper knowledge on *Campylobacter* ecological interaction with the host is needed. Here, gut microbiota composition of infected and non-infected broilers was compared to identify modifications that could anticipate gut colonisation by *Campylobacter jejuni*. Four broiler farms, half of them being positive for *Campylobacter*, were enrolled. Caecal samples were collected from each farm at different time points (days 7, 14, 18, 21 and 28 of life). V3-V4 16S rRNA gene regions were amplified and sequenced using HiSeq2500 Illumina platform. Reads were filtered and cleaned using in-house methods and pre-processed using QIIME pipeline to obtain the final operational taxonomic unit (OTU) table. OTUs' proportional abundance, number and taxonomic classification were investigated to describe community diversity in terms of alpha and beta indices. Additionally, a differential abundance analysis was performed to check for differences in temporal evolution of *Campylobacter* between negative and positive farms and among the positive farms. Finally, population dynamics was investigated through the reconstruction of inter-genera interaction networks, inferred starting from data on the microbial community composition. Results showed a difference in alpha diversity between negative and positive samples, with *Lactobacillus* and *Faecalibacterium* found to inhibit *Campylobacter* gut colonisation. Novel approaches aimed to restore the birds' microbial barrier during *Campylobacter* infection might benefit from the findings of the present study. This might help develop new control strategies in order to mitigate the risk of *C. jejuni* in humans, as well as to classify farms in terms of risk of the presence and spread of *Campylobacter*.

Bovine cysticercosis (*Taenia saginata*) and diagnostic status in Poland

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Taenia saginata, known as the beef tapeworm, is a zoonotic tapeworm belonging to the order Cyclophyllidea and genus *Taenia*. It is found globally, especially in areas where cattle are raised and raw beef is consumed. This intestinal parasite causes human taeniasis and cysticercosis in cattle. Cattle are the intermediate hosts. Infective larvae in beef meat are called cysticerci. From humans, embryonated eggs, called oncospheres, are released with faeces and are transmitted to cattle through contaminated feed. Within eight weeks, oncospheres develop inside the muscle, liver, and lungs of the cattle into infective cysticerci and remain viable for years. EU official examination data indicate an increase in the presence of cysticercosis in cattle populations. The relevance of cysticercosis could be underestimated due to gaps in control measures. In Poland, *T. saginata* cysts in cattle are traditionally found at the time of visual inspection, palpation or incisions of masseters and heart. According to EU Regulation 627/2019, the competent authorities may decide that incision of the masseters at post-mortem inspection is not compulsory if: a specific serological test is used, or the animals have been raised on a holding of provenance officially certified to be free of cysticercosis, or the prevalence in the source population or in a well-defined subpopulation is below one in a million. But according to 2017/625, the methods of sampling and diagnostics during official controls must comply with EU regulations specifying these methods or with the effectiveness criteria for such methods. Unfortunately, no serological tests for cattle testing for cysticercosis have been explicitly mentioned in EU legislation. Other tests may be used if they are internationally recognised, e.g. by the European Committee for Standardization (CEN) or recommended by European Union Reference Laboratories (EURL) and validated according to internationally recognised scientific protocols. According to the information obtained from the EURL on July 16, 2020, no test has been developed or validated by EURL to test cattle for cysticercosis. Therefore, the serological tests available on the market for testing cattle for cysticercosis do not meet the criterion mentioned above. The incidence of cysticercosis in bovines based on official data for 2016-2019 in Poland decreased from 438 cases per 1,000,000 in 2016 to 271 cases per 1,000,000 in 2019, which makes it impossible to use this criterion to grant exemptions from incising the masseter muscles. To adopt modern solutions in supervision, it would be necessary to take steps to validate the serological test for cysticercosis in bovine animals by EURL and to take action at the farm level in Poland.

Meat as a source of viral foodborne infections – a rising problem

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Food Safety Control is mainly focused on bacterial pathogens and, to a lesser extent, parasites, while viruses are most commonly neglected. However, there is a wide range of foodborne viruses that creates a substantial risk for consumers of meat and meat products, especially those served raw or mildly processed. The foodborne viruses are shed in human faeces and are infectious when ingested via the oral route. These viruses can be divided into three main categories. Firstly are the viruses responsible for gastroenteritis, manifested by vomiting and diarrhoea, represented by noroviruses, rotaviruses, astroviruses, adenoviruses and sapoviruses. Most commonly, the acute human cases of gastroenteritis worldwide are related to norovirus. Noroviruses can also be found in a variety of other food animals including pigs and cattle. The similarity between human and porcine noroviruses suggests the possibility of zoonotic transmission. The second group of viruses comprises agents causing enterically transmitted hepatitis after they migrate to the liver, with hepatitis A virus (HAV) and hepatitis E virus (HEV) as examples. The viruses from the third category replicate in the human intestine but only cause illness after they migrate to other organs such as the central nervous system (enterovirus). There is also an additional group of viruses that can occasionally be transmitted via food, although their typical mode of infection is different, such as SARS-coronaviruses and highly pathogenic avian influenza virus (HPAIV). The major routes of viral contamination of foods are human faeces, infected food handlers and animals for the zoonotic viruses. Virus contamination can occur at any stage of production. Food preparation areas typically become contaminated with human viruses when a food handler is ill at work. Viruses can survive on aluminium, stainless steel, plastic, latex, polystyrene and paper. Non-enveloped viruses, such as HAV and norovirus, are resistant to many disinfectants. Ineffective cleaning at the abattoir will allow infectious virus to remain viable on environmental surfaces. Although most gastrointestinal tract viruses induce disease with prominent symptoms, infection can also be asymptomatic and limited to viral shedding. An additional risk is created by zoonotic foodborne viruses, like HEV genotypes 3 and 4 (HEV-3 and HEV-4) that are endemic in piggeries and can be found in wild boar. The highest HEV prevalence was found in pork liver pàtés, dry-cured sausages containing pig liver, game meat and food contaminated by pig/wild boar faeces. Most HEV infections in humans are subclinical. There is also an important risk of non-oral transmission of foodborne zoonotic viruses for occupational groups like abattoir workers, veterinarians and butchers, who can be infected through animal blood, body fluids and excretions via skin lesions and mucous membranes or by inhalation of aerosols. Such a scenario is assumed in the cases of HIV, SARS-coronaviruses and Ebola crossing the species barrier during the butchering process of infected animals. The control of viral hazards requires different measures to those routinely employed to eliminate bacterial agents. The current food hygiene guidelines need to be updated for the prevention of viral infections. This is an issue of growing importance nowadays, as the world faces high human immigration/migration, travel and new cuisine habits.

Meat Safety Assurance Systems and Quality Culture applied in the Romanian meat industry

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The aim of this study is to investigate issues regarding the potential application of a new Meat Safety Assurance System (MSAS) in the Romanian meat industry. The study explores current meat safety assurance practices used and key elements of the MSAS that will be implemented. The study is based on an exploratory method with a qualitative approach based on interviews with Quality Managers of the production facilities. Other secondary data were collected through audit report analysis and official controls. The study could be a tool to investigate the potential application of new elements of the MSAS, especially expected outcomes that are additional to food safety (for example non-food safety outcomes such as authenticity, labelling and composition, and consumer expectations). The present study has attempted to address issues related to the implementation of the new MSAS, by understanding critical factors of the MSAS applicable in the local industry. The research evidence demonstrates a quality-driven organisational strategy that aims to bind quality improvement initiatives with strategic efforts. Based on research methods and a literature review, one crucial issue is the Quality Culture dimension in organisations, with a particular definition for the food industry, where quality and safety of the product for customer health and satisfaction are the most important performance parameters. The research evidence also demonstrates that an organisation with a strong Quality Culture is more willing for this new step in evolution regarding new elements of the MSAS. Limitations of the study were that the explored organisations are not yet applying these new elements of the MSAS, but they have the potential for this new approach.

Food safety – Risk analysis in the meat industry

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Food business operators must control food hazards by developing and implementing food safety programs based on HACCP principles. Thus, risk analysis has become a priority for researchers and decision-makers. This rapid development also resulted from the fact that international organisations (World Trade Organization, International Office of Epizootics, Codex Alimentarius Commission, International Convention for the Protection of Plants) have urged states to resort to risk analysis methods, considering that international norms alone are not appropriate to meet the levels of protection they have determined for the human, animal or plant populations. The risk is defined by the NACMF (National Advisory Committee on Microbiological Criteria of Foods) as an element of a biological, physical or chemical nature that may pose a threat to consumer health. A food product can be associated with three categories of risks: biological, chemical and physical. The operator must consider and describe the control measures, if any, that can be applied for each hazard, to eliminate them or to reduce their impact or likelihood of occurrence at acceptable levels. In the meat industry, risk analysis has been a hotly debated topic lately, given that most foodborne illnesses and toxin infections come from meat consumption either as raw (beef tartare, etc.) or partially prepared (beef in the blood), or as a result of manipulation of meat by people infected or going through the disease who have remained carriers and eliminators of pathogens. Meat can be contaminated with genera such as *Salmonella*, *Staphylococcus*, *Listeria*, *Clostridium* and *Escherichia*, a real biological danger to the end consumer. Currently, the aim is to prevent the hazards that could appear during the technological flow and not only during factory processing, thus taking into account the restaurants that produce dishes made from raw and semi-prepared meat partially at the consumer's request.

Salmonella sharing between wild boars (*Sus scrofa*) and humans in Italy

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The study assessed *Salmonella* carriage in wild boars (*Sus scrofa*) and compared their isolates with those recovered from the human population of the same area of northern Italy (Emilia-Romagna region). Altogether, 305 wild boars hunted during two hunting seasons (2017-2018; 2018-2019) were tested for *Salmonella* in mesenteric lymph nodes (MLNs) and faecal samples. Forty-four *Salmonella* isolates were detected in 35 MLNs (11.5% - 95% CI: 8.4 –15.5%) and 9 faecal samples (3.0%; 95% CI 1.6 – 5.5%). Fourteen serovars were identified, *i.e.* Bovismorbificans, Brandenburg, Coeln, Derby, Enteritidis, Gaminara, Hessarek, Houtenae, O:40, Kottbus, Napoli, Stanleyville, Thompson, Typhimurium and Veneziana. The most common serovars were Typhimurium, Stanleyville and Kottbus, accounting for 14, 7, and 4 of the isolates, respectively. Only two strains of *S.* Enteritidis were detected in MLNs (1/305) and faeces (1/305) of different animals. The 44 isolates from wild boars were compared with 4,151 isolates from humans detected in the five-year period 2015-2019 in the same region of Italy. All the serovars detected in wild boars were also found in humans, but large differences in prevalence were observed. Specifically, *S.* Enteritidis ranked second among the human isolates and accounted for 11.7% of the 4,151 isolates of human origin. *S.* Typhimurium, *S.* Napoli, *S.* Brandenburg, *S.* Derby and *S.* Coeln accounted for 8.7%, 4.2%, 3.0%, 2.4% and 1.1% of the human isolates, respectively. The other serovars were found rarely in human patients, ranging from 1.0% (*S.* Bovismorbificans) to 0.02% (*S.* Gaminara and *S.* Kottbus) of the human isolates. Among the most common *Salmonella* serovars carried by wild boars, only *S.* Typhimurium was frequently isolated from human patients, ranking third (380 isolates/4,151) in the same region of the country. On the contrary, *S.* Stanleyville and *S.* Kottbus were very rarely responsible for human salmonellosis, accounting for 4/4,151 and 1/4,151 of the isolates, respectively. Furthermore, the detection of *S.* Napoli in wild boars is of concern, because it ranked fourth (176/4,151) among the *Salmonella* serovars responsible for human cases in the region of the study. In conclusion, our study suggests that wild boar meat could be responsible for human cases of salmonellosis, with special regard to some serovars (*i.e.* Typhimurium and Napoli). Nevertheless, since most of the serovars were rarely found in humans, cooking wild boar meat and offal until it is well-done, which is usual in this region of Italy, might reduce the risk for consumers. In addition, consumption of wild boar meat is much less common than pig meat, thus limiting transmission of pathogens in comparison to pork products.